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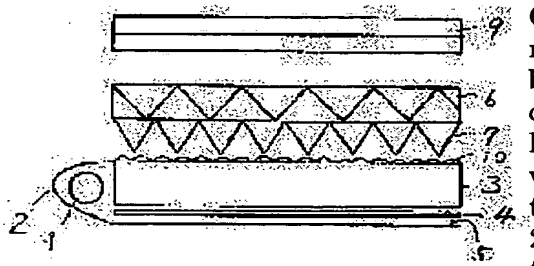
(54) ILLUMINATION DEVICE AND LIQUID CRYSTAL DISPLAY DEVICE



(57)Abstract:

PURPOSE: To provide the liquid crystal display device and illumination device having high efficiency of utilizing light by providing the light exit side surface of a surface light transmission body with a light deflecting means and further, arranging a polarized light separator thereon.

CONSTITUTION: The polarized light separator 6 which is a multilayered structural body is combined with an edge light type back light which is formed by bringing a fluorescent lamp (cold cathode discharge tube) 1 into tight contact with one side of a light transmission body 3 made of a transparent acrylic resin which is an illumination surface and providing the light transmission body in which the light is guided with a lamp cover 2 consisting of a reflector. Further, the rear surface of the light transmission body 3 and the light transmission body flank opposite to the surface to be installed with the fluorescent tube are provided with a phase difference plate 4 and a reflection surface consisting of a reflection film made of an Al metallic sheet is formed thereon. A prism array having an isosceles triangle shape in sectional shape is used as a prism array 7 and is so arranged that its vertexes face to the light transmission body 3. The polarized light separator 6 are mounted thereon and further, a diffusion plate 8 is used on the light exit surface side of the polarized light separator 6 in order to widen a visual field angle.

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[Claim(s)]
[Claim 1] While the light source is arranged in the lighting system which becomes the light source and the light source from the field-like transparent material by which contiguity arrangement was carried out so that incidence of the light may be carried out from the flank of a field-like transparent material The lighting system characterized by having arranged the polarization eliminator with which an optical deflection means by which the light which carries out outgoing radiation became a right angle mostly to a field-like transparent material front face was established, and the cross section carried out the laminating of the polarization detached core to the optical outgoing radiation side side of a field-like transparent material on it further at the array-like part of a triangle-like pillar-shaped prism array.
[Claim 2] An optical deflection means is a lighting system with which it is characterized by a cross section being a triangle-like pillar-shaped prism array in a lighting system according to claim 1.
[Claim 3] The lighting system characterized by consisting of a multilayer-structure object with which a polarization detached core comes to carry out the laminating of the translucency medium with a small refractive index by turns relatively [medium / with a big refractive index / translucency] relatively in a lighting system according to claim 1 or 2.
[Claim 4] The lighting system characterized by consisting of a dielectric thin film with which a polarization detached core has the above thickness of 1000nm or less further at least in a lighting system according to claim 1 or 2.
[Claim 5] The liquid crystal display characterized by having arranged the lighting system claim 1 - given in 4 any 1 terms at the tooth back of a liquid crystal display component as the average polarization shaft orientations of the beam of light which carried out outgoing radiation of the lighting system, and the polarization shaft orientations of the polarizing plate by the side of the optical incidence in a liquid crystal display component carry out abbreviation coincidence.

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the plane lighting system formed behind the liquid crystal display component using the liquid crystal display method which is used for a liquid crystal television, the liquid crystal display for computers, etc., and which modulates the polarization condition of linearly polarized light incident light, and the direct viewing type liquid crystal display using it.
[0002]
[Description of the Prior Art] In recent years, many displays of display grace in which the technical progress of the liquid crystal display using a liquid crystal display component, especially a color display component is not inferior to **** better ** and CRT came to be seen.
[0003] In monochrome display, although the reflective mold liquid crystal display component which does not use the back light which is a flat-surface lighting system before several years was in use, current is replaced with the transparency mold liquid crystal display component using a back light for almost also in monochrome display. Moreover, a notebook computer goes into a spread phase and the back light loading mold came to overwhelm the commercial scene. In the color display liquid crystal display, voice as a display is not made without a back light, but the back light serves as an indispensable device in a direct viewing type liquid crystal display.
[0004] A color liquid crystal display is divided roughly, has two methods of the TN liquid crystal display and the STN liquid crystal display of a multiplexer drive by the active-matrix drive using TFT, has the composition that the optical optical incidence [of the component for which all held the liquid crystal layer with the glass substrate], and outgoing radiation side was equipped with the polarizing plate, modulates the polarization condition of linearly polarized light incident light, and holds a liquid crystal display method.
[0005] Although the intensity level required of a back light varies with the application, in a color notebook computer, especially not only demand brightness but thin-shape-izing, lightweight-izing, and power-saving (a dc-battery drive is a premise) are a supreme proposition.
[0006]
[Problem(s) to be Solved by the Invention] since [however,] the polarization direction of liquid crystal display component incident light is irregular and it is random polarization -- TN mold and a STN mold -- more than one half will be absorbed among incident light with the polarizing

plate with which the incidence side of a display device was equipped, in [any] a liquid crystal device, efficiency for light utilization is low, and it serves as the display screen dark as a result. Or in order to make it bright, there was a problem that power consumption will increase.
[0007] The depth of equipment is received like [in order to solve these problems / in the case of using a liquid crystal display for a transparency mold projector as the optical modulator especially]. When tolerance is large For example, the polarization eliminator which divides unpolarized light into the polarization light which intersects perpendicularly with each other is made to intervene a light source lamp, a liquid crystal display, and in between like JP,4-184429,A. One light carries out direct outgoing radiation of the polarization eliminator, and converging the light of another side on a light source lamp, and using it as a light source light again is proposed.
[0008] By the way, although there are various methods in making a flat-surface lighting system, it divides roughly and is classified into two sorts. General most methods are methods called a Terumitsu Uchibe method or direct female mold, and are methods which have the light source inside an illumination side. On the other hand, an edge light mold is a method which the light source is arranged outside an illumination side, and is made to stick for example, approximate line-like illuminants, such as a fluorescent lamp (for many to be cold cathode discharge tubes), to one side of the transparent material which consists of a transparent acrylic resin plate which is an illumination side, or two sides, prepares the lamp cover which consists of a reflector, and introduces light in a transparent material. Since it ****** thin-shape-izing and lightweight-ization especially in a color notebook computer, an edge light mold back light is effective.
[0009] Although it was theoretically considered to be possible to apply the technique of JP,4-184429,A described previously to the flat-surface lighting system of a Terumitsu Uchibe method, the effective approach was not proposed to the edge light mold back light.
[0010] This invention aims at solution of the above-mentioned fault of the conventional technique.
[0011]
[Means for Solving the Problem] While the light source is arranged in the lighting system which this invention is made that the above-mentioned technical problem should be solved, and becomes the light source and the light source from the field-like transparent material by which contiguity arrangement was carried out so that incidence of the light may be carried out from the flank of a field-like transparent material An optical deflection means by which the light which carries out outgoing radiation to the optical outgoing radiation side side of a field-like transparent material becomes a right angle mostly to a field-like transparent material front face is established. Furthermore on it, a cross section provides the array-like part of a triangle-like pillar-shaped prism array with the lighting system characterized by having arranged the polarization eliminator which carried out the laminating of the polarization detached core, and the liquid crystal display using this.
[0012] The polarization eliminator used for the lighting system of this invention is SID 92 Digest p.427. As shown The polarization detached core which a polarization eliminator becomes from the multilayer-structure object using the cross protection of light which comes to carry out the laminating of the translucency medium with a small refractive index by turns relatively [medium / with a big refractive index / translucency] relatively It has the structure to which the cross section in a field including the average optical axis of the beam of light which carries out outgoing radiation carried out the laminating of that of pillar-shaped triangle-like prism to the array-like structure.
[0013] Moreover, what consists of a dielectric thin film which has the above thickness of 1000nm or less further at least as a polarization detached core may be used. The following is explained taking the case of what used the multilayer-structure object as a polarization detached core.
[0014] Drawing 2 shows such a polarization eliminator. As shown in drawing 2 , 11 and 13 are the array-like structures of the pillar-shaped prism of the shape of a triangle which consists of a transparent material like a polycarbonate. Triangular one corner facing the field-like transparent material of pillar-shaped triangle-like prism is 85 degrees to 95 degrees, and is about 90 degrees still more preferably. 12 is a multilayer-structure object using the cross protection of light which comes to carry out the laminating of the translucency medium with a small refractive index by turns relatively [medium / with a big refractive index / translucency] relatively. The multilayer-structure object 12 has isolation for polarization to the field to the light which carries out incidence from across. Especially in this invention, a multilayer-structure object is designed and used so that polarization isolation may be discovered to the light which carries out incidence from a 45-degree direction.
[0015] The unpolarized light light of 14 is separated into the p-polarized light light of 16, and the s-polarized light light of 15 by the

multilayer-structure object, the p-polarized light light 16 penetrates the multilayer-structure object 12, it reflects twice and the s-polarized light light 15 returns. Thereby, it can use as a polarizing element of a non-light absorption mold.
[0016] The configuration on the front face of a transparent material is chosen from the transparent material of an edge light mold back light so that total reflection conditions may be avoided. The approach of forming a white dispersing agent in a transparent material front face and the approach of forming a lenticular sheet or the Fresnel configuration of prism in a transparent material front face are learned about the configuration on the front face of a transparent material of avoiding this total reflection condition.
[0017] However, generally, even if it is difficult for the field to take out light at a right angle and carries out the above works, it cannot usually take out from a transparent material from 20 degrees to 35 degrees. Then, an optical deflection means by which the light which carries out outgoing radiation to the optical outgoing radiation side side of a field-like transparent material becomes a right angle mostly to a field-like transparent material is established.
[0018] An optical deflection means is the thing of the structure in which the cross section in a field including the average optical axis of the beam of light which carries out outgoing radiation of the inside of a field-like transparent material has arranged pillar-shaped triangle-like prism in the shape of an array. It is desirable that triangular one corner facing the field-like transparent material of the pillar-shaped prism of the shape of a triangle of an optical deflection means is made into 50 to 75 degrees.
[0019] By such configuration, after the p-polarized light component which penetrated the multilayer-structure object penetrates a polarizing plate, incidence of it is carried out to a liquid crystal display component, and an s-polarized light component is reflected into a field-like transparent material. In case this s-polarized light component pulled back repeats reflection and a light guide is carried out on the front face of a field-like transparent material, a phase change arises, a p-polarized light component is generated, and it may come to penetrate said multilayer-structure object. Therefore, the component changed into a p-polarized light component by things repeating reflection on a field-like transparent material front face arises, and the s-polarized light component reflected with the multilayer-structure object also contributes to the component penetrated to a liquid crystal display component. Consequently, the quantity of light losses by taking out linearly polarized light light using a multilayer-structure object are few, and the plane lighting system which functions as the linearly polarized light flat-surface light source with the high efficiency for light utilization to a liquid crystal display component is obtained.
[0020] In the liquid crystal display of this invention, the case where it applies to an edge light mold flat-surface lighting system is explained in full detail below using drawing 1 which is the block diagram.
[0021] The fluorescent lamp 1 (cold cathode discharge tube) which has the luminescence length corresponding to the die length of a transparent material side face is stuck to one side of the transparent acrylic resin plate transparent material 3 which is an illumination side, the lamp cover 2 which consists of a reflector is formed, and lamp outgoing radiation light is introduced in a transparent material. At this time, the directivity (angular distribution) of the light which spreads the inside of a transparent material is decided by the propagation property of the condensing property and light guide plate of the luminous-intensity-distribution property and reflector of a fluorescent lamp etc. If especially the propagation property of a transparent material is not what combines the function to send ahead the light which carried out incidence from the transparent material edge, and the function which carries out outgoing radiation of the sent light in the predetermined direction, it will not become.
[0022] The former function is total reflection angle thetac which is decided according to the ingredient and interface reflection property to be used, and becomes settled with the refractive index of a transparent material 3 in the liquid crystal display component 10 side of a transparent material 3. Total reflection of the light of the above incident angle is carried out, the inside of a transparent material 3 is spread, and it is total reflection angle thetac. The light of the following incident angles is refracted on the front face of a transparent material 3, and outgoing radiation is carried out to the liquid crystal display component 10 side. For example, total reflection angle thetac in the interface of plastics (n is about 1.5), such as air (n= 1.0), transparence resin, for example, an acrylic, a polycarbonate, polyurethane, and polystyrene, It becomes following several 1 extent.
[0023]
[Equation 1] thetac =sin-1(1/n) =41.8 degree[0024]
That is, the incident light of 41.8 or less degrees can carry out [an incident angle] outgoing radiation from the illumination side of a transparent material 3.
[0025] On the other hand, in a field opposite to

the liquid crystal display component of a transparent material, if the reflector 5 of an aluminum reflector etc. is formed, the light guide of the reflected light will be carried out in the inside of a transparent material as the normal reflected light. In addition, a reflector 5 is good also as a diffuse reflector in order to increase the outgoing radiation light in liquid crystal display component 9 side face of a transparent material 3.
[0026] On the other hand, the incident angle of the light to a transparent material 3 is total reflection angle thetac. Since the light by which outgoing radiation is carried out to the case where it is above being most from a transparent material becomes small, the function which avoids total reflection conditions and carries out outgoing radiation to the liquid crystal display component 9 side of a light guide plate 3 is needed. although the approach of forming an optical white dispersing agent in the front face of a transparent material 3 and the approach of forming a lenticular sheet or the Fresnel configurations (a micro-lens array, prism array, etc.) 10 of prism in a transparent material front face are learned as the means, linearly polarized light light does not have profit as an outgoing radiation light only by such approach.
[0027] In an edge light mold back light, there is no directivity of the light which spread and carried out outgoing radiation of the transparent material as mentioned above in the angle of visibility of the watcher of a liquid crystal display component, i.e., the perpendicular direction of a liquid crystal display component side. Incidence is carried out at the include angle of 20 to 40 degrees to the multilayers structure of a polarization eliminator. Thus, when changing into the perpendicular direction of an illumination side luminous-intensity-distribution distribution of the flat-surface lighting system which has the partial luminous-intensity-distribution distribution, it is effective to form a lenticular sheet or the Fresnel configurations (a micro-lens array, prism array, etc.) of prism.
[0028] The case where the inside of a transparent material 3 has been arranged to juxtaposition in the direction of an optical axis of the light to spread is shown in drawing 1 in the prism array 7 between a polarization eliminator and ********. That is, the cross section in a field including the average optical axis of the beam of light which carries out outgoing radiation of the inside of a field-like transparent material in this case arranges pillar-shaped triangle-like prism in the shape of an array. The optimal configuration is determined from luminous-intensity-distribution distribution bearing and luminous-intensity-distribution distribution bearing of multilayer-structure object outgoing radiation light which total reflection may happen in respect of the case of only refraction arising in respect of the plane of incidence of prism, and outgoing radiation, and others, and finally need an operation of a prism array according to the configuration and arrangement (do you make a prism vertical angle into an optical incidence side, or turn on an optical outgoing radiation side?).
[0029] In drawing 1 , using the prism array of two equilateral triangles whose cross-section configurations are 58 degrees of vertical angles, it arranges so that a vertical angle may face multilayer-structure dignity. By using such a prism array, after it carries out incidence of the light penetrated on the about 56-degree outgoing radiation square from the field-like transparent material from a prism side face and it carries out total reflection on other side faces, corresponding to the direction of vertical incidence, outgoing radiation of it is carried out to a liquid crystal display component side from a prism base. therefore, luminous-intensity-distribution bearing of the light emitted on an about 56-degree outgoing radiation square from a multilayer-structure object by using such a prism array -- a liquid crystal display component side -- a perpendicular direction -- it is mostly convertible for luminous-intensity-distribution bearing.
[0030] Thus, the linearly polarized light flat-surface lighting system which illuminates a liquid crystal display component in the perpendicular luminous-intensity-distribution bearing is obtained. The directivity of the light which spreads the inside of a transparent material is high, luminous-intensity-distribution bearing distribution of the light by which outgoing radiation is carried out as a result from a flat-surface lighting system may concentrate perpendicularly, and the range of the angle of visibility corresponding to a bright display may become narrow. When such, the optical element of the diffusion plate 8 grade which degrades directivity between a liquid crystal display component and deflection means, such as an above-mentioned prism array, can be arranged.
[0031] Moreover, in order to degrade the directivity of the light which spreads the inside of a transparent material, it is good also considering the reflector 5 formed in the liquid crystal display component and opposite side side of a transparent material as the diffusing surface. Moreover, it is good also as what has detailed concavo-convex structure so that light scattering may also produce the multilayer-structure object itself in the structure interface.
[0032] In order to obtain linearly polarized light light from a flat-surface flat-surface lighting

system efficiently in this invention, it is important to change efficiently [while spreading the inside of a transparent material] into p-polarized light light the s-polarized light component which was reflected in the multilayer-structure object and pulled back in the transparent material, and to reuse it. Although various methods of changing this s-polarized light light into p-polarized light light exist, the example of representation is described below.
[0033] Generally, when linearly polarized light light carries out oblique incidence to a metal side and is reflected in it, it is known that linearly polarized light light will turn into elliptically-polarized-light light according to a metaled optical physical property value (a refractive index n, an absorption coefficient k). That is, even if s-polarized light light carries out incidence, a p-polarized light component is generated by the reflected light. Therefore, when the reflectors 5 formed in the liquid crystal display component 9 of a transparent material 3 and the field of the opposite side in this invention are metals, such as aluminum, whenever it is reflected in this reflector, a part of s-polarized light light is changed into p-polarized light light.
[0034] The phase contrast plate which consists of translucency polymeric materials as another approach as a component which rotates polarization shaft orientations is known. By arranging this phase contrast plate 4 that has suitable thickness between the reflectors 5 of a transparent material 3, the s-polarized light light reflected by the polarization eliminator turns into elliptically polarized light, and can change that part into p-polarized light light. Drawing 1 shows the example of a configuration which is made to stick this 1 / 4 phase-contrast plate 4 on the reflector 5 established in the transparent material 3, and performs polarization conversion efficiently.
[0035] Moreover, although the above explanation described the case where an acrylic was used as transparence resin used for a transparent material, a polycarbonate, polyurethane, polystyrene, silicone, etc. are sufficient.
[0036]
[Example] The example of this invention is explained referring to drawing 1 . The fluorescent lamp 1 (cold cathode discharge tube) was stuck to one side of the transparent acrylic resin plate transparent material 3 which is an illumination side, and the polarization eliminator 6 which is a multilayer-structure object was combined in the edge light mold back light which forms the lamp cover 2 which consists of a reflector, and introduces light in a transparent material.
[0037] As a fluorescent lamp 1, it has the die length corresponding to the side-face length (152mm) of a 10 inch liquid crystal display side, and the cold cathode discharge tube of 10W with a thin tube diameter was used. Moreover, as a lamp cover 2, magnitude used the 160mmx220mmx5mm thing for the reflecting mirror of a cylindrical shape or an ellipse cartridge which wraps in a cold cathode discharge tube as a transparent material 3 with the translucency light guide plate made of acrylic resin (n is about 1.5).
[0038] Furthermore, the phase contrast plate 4 was formed in the transparent material side face which counters the rear face and fluorescent lamp installation side of a transparent material 3, and the reflector which consists of aluminum metallic reflection film was formed on it. Moreover, as a prism array 8, using the prism array of two equilateral triangles whose cross-section configurations are 58 degrees of vertical angles, it has arranged so that a vertical angle may face a light guide plate 3. The thickness of a prism array plate set the pitch of a prism array to about 1mm by 2mm. It equipped with the polarization eliminator 6 on it. Furthermore, the diffusion plate 8 was used for the optical outgoing radiation side side of the polarization eliminator 6 in order to extend an angle of visibility.
[0039] As a liquid crystal display component 9, it is TN liquid crystal of a TFT drive, and the RGB color TFT drive TN liquid crystal display cel which has the number of pixels corresponding to VGA was used.
[0040] Abbreviation coincidence of the polarization shaft of the outgoing radiation light of the polarization eliminator 6 and the polarization shaft of the incidence side polarizing plate of the liquid crystal display component 9 was carried out.
[0041] The outgoing radiation side polarizing plate of the liquid crystal display component 9 used the light absorption mold organic polarizing plate similarly. Although the sense of a polarization shaft was suitably chosen by the display mode (a normally white, normally black), in this example, it was a normally white display and the polarization shaft of the polarizing plate of an outgoing radiation side face was taken in the direction which 90-degree polarization shaft rotated to the polarization shaft of the polarizing plate of an incidence side face. The fluorescent lamp of 10W was used for the light source.
[0042] As a result of performing the case where the phase contrast plate 4 and the polarization eliminator 6 are not used, as an example of a comparison, the example was 1.5 times as larger as the example of a comparison.
[0043]

[Effect of the Invention] By this invention, a liquid crystal display with the high use effectiveness of light and the lighting system suitable for it are obtained.

[Brief Description of the Drawings]
[Drawing 1] The sectional view having shown the example of this invention
[Drawing 2] The sectional view having shown the polarization eliminator of this invention
[Description of Notations]
1: Fluorescent lamp
2: Lamp cover
3: Transparent material
4: Phase contrast plate
5: Reflector
6: Polarization eliminator
7: Prism array
8: Diffusion plate
9: Liquid crystal display component

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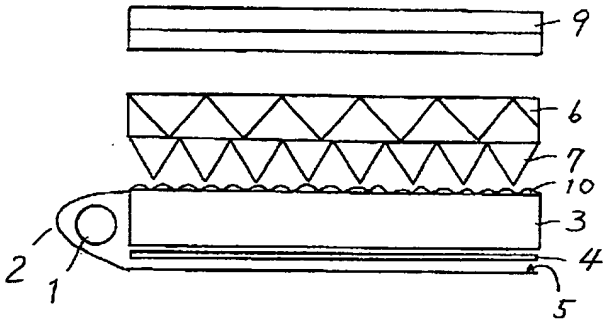
(54)【発明の名称】　照明装置および液晶表示装置

(57)【要約】

【目的】光の利用効率の高い液晶表示装置と、それに適した照明装置を得る。

【構成】エッジライト型照明装置において、面状導光体３の光出射面側に、出射する光が面状導光体表面に対してほぼ直角になるような光偏向手段７を設け、さらにその上に、断面が三角形状の柱状プリズムアレイのアレイ状部分に偏光分離層を積層した偏光分離器６を配置した。



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【特許請求の範囲】

【請求項１】光源と光源に近接配置された面状導光体とからなる照明装置において、光源は面状導光体の側部から光が入射されるように配置されているとともに、面状導光体の光出射面側に、出射する光が面状導光体表面に対してほぼ直角になるような光偏向手段を設け、さらにその上に、断面が三角形状の柱状プリズムアレイのアレイ状部分に偏光分離層を積層した偏光分離器を配置したことを特徴とする照明装置。

【請求項２】請求項１記載の照明装置において、光偏向手段は、断面が三角形状の柱状プリズムアレイであることを特徴とする照明装置。

【請求項３】請求項１または請求項２記載の照明装置において、偏光分離層が相対的に屈折率の大きな透光性媒質と相対的に屈折率の小さな透光性媒質とを交互に積層してなる多層構造体からなることを特徴とする照明装置。

【請求項４】請求項１または請求項２記載の照明装置において、偏光分離層が少なくとも一層以上の１０００ｎｍ以下の厚みを有する誘電体薄膜からなることを特徴とする照明装置。

【請求項５】照明装置を出射した光線の平均的な偏光軸方向と液晶表示素子における光入射側の偏光板の偏光軸方向とが略一致するようにして、請求項１～４いずれか一項記載の照明装置を液晶表示素子の背面に配置したことを特徴とする液晶表示装置。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】本発明は、液晶テレビ、コンピュータ用液晶ディスプレイ等に用いられる、直線偏光入射光の偏光状態を変調する液晶表示方式を用いた液晶表示素子の背後に設ける平面状照明装置、およびそれを用いた直視型液晶表示装置に関する。

【０００２】

【従来の技術】近年、液晶表示素子、特にカラー表示素子を用いた液晶表示装置の技術進歩は目ざましく、ＣＲＴに劣らぬ表示品位のディスプレイが数多く見られるようになった。

【０００３】白黒表示においては、数年前まで平面照明装置であるバックライトを用いない反射型液晶表示素子が主流であったが、現在は白黒表示においてもほとんどバックライトを用いる透過型液晶表示素子に置き換わっている。また、ノートパソコンが普及段階に入り、バックライト搭載型が市場を席巻するに至った。カラー表示液晶ディスプレイでは、バックライトなしではディスプレイとしての態をなさず、バックライトは直視型液晶表示装置における必須デバイスとなっている。

【０００４】カラー液晶表示装置は、大別してＴＦＴを用いたアクティブマトリクス駆動によるＴＮ液晶表示装

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方式があり、いずれも液晶層をガラス基板で保持した素子の光入射側および光出射側に偏光板が装着された構成となっていて、直線偏光入射光の偏光状態を変調して液晶表示方式を行うものである。

【０００５】バックライトに要求される輝度レベルはその用途によって様々であるが、特にカラーノートパソコンでは要求輝度だけでなく薄型化・軽量化・省電力化（バッテリー駆動が前提）は至上命題である。

【０００６】

【発明が解決しようとする課題】しかし、液晶表示素子入射光の偏光方向は不揃いでランダム偏光であるため、ＴＮ型およびＳＴＮ型いずれの液晶素子の場合も表示素子の入射側に装着された偏光板により入射光のうち半分以上が吸収されてしまい光利用効率が低く、結果的に暗い表示画面となってしまった。あるいは、明るくするためには電力消費量が増加してしまうといった問題があった。

【０００７】これら問題を解決するため、特に、透過型プロジェクターに液晶表示装置をその光変調器として使う場合のように、装置の奥行きに対して許容度が大きいときには、例えば特開平４－１８４４２９号のように、光源ランプと液晶表示装置と間に無偏光光をお互いに直交する偏光光に分離する偏光分離器を介在させ、一方の光は偏光分離器を直接出射させ、他方の光は光源ランプに集束させて再び光源光として、使用することが、提案されている。

【０００８】ところで、平面照明装置を作るには種々の方式があるが、大別して２種に分類される。一般的に最も多い方式は内部照光方式あるいは直下型といわれる方式で、光源が照光面の内側にある方式である。一方、エッジライト型は光源が照光面の外に配置され、照光面である透明なアクリル樹脂板などからなる導光体の一辺もしくは二辺に蛍光ランプ（多くは冷陰極放電管）等の例えば略線状発光体を密着させ、反射体からなるランプカバーを設けて導光体内に光を導入する方式である。カラーノートパソコンでは特に薄型化・軽量化をが要求されるため、エッジライト型バックライトが有効である。

【０００９】内部照光方式の平面照明装置に対しては、さきに述べた特開平４－１８４４２９号の技術を応用することが原理的には可能と考えられるが、エッジライト型バックライトに対しては、有効な方法は提案されていなかった。

【００１０】本発明は、従来技術の前述の欠点の解決を目的とする。

【００１１】

【課題を解決するための手段】本発明は、前述の課題を解決すべくなされたものであり、光源と光源に近接配置された面状導光体とからなる照明装置において、光源は面状導光体の側部から光が入射されるように配置されて

が面状導光体表面に対してほぼ直角になるような光偏向手段を設け、さらにその上に、断面が三角形状の柱状プリズムアレイのアレイ状部分に偏光分離層を積層した偏光分離器を配置したことを特徴とする照明装置、および、これを用いた液晶表示装置を提供するものである。

【００１２】本発明の照明装置に用いる偏光分離器は、例えば、SID 92 Digest p.427 に示されているように、偏光分離器が光の干渉効果を利用した相対的に屈折率の大きな透光性媒質と相対的に屈折率の小さな透光性媒質とを交互に積層してなる多層構造体からなる偏光分離層を、出射する光線の平均的光軸を含む面での断面が三角形状の柱状プリズムのをアレイ状構造物に積層した構造を有する。

【００１３】また、偏光分離層として、少なくとも一層以上の１０００ｎｍ以下の厚みを有する誘電体薄膜からなるものを用いてもよい。以下は、偏光分離層として多層構造体を用いたものを例にとり説明する。

【００１４】図２はこのような偏光分離器を示したものである。図２に示すように、１１、１３はポリカーボネートのような透明材料からなる三角形状の柱状プリズムのアレイ状構造物である。三角形状の柱状プリズムの面状導光体に面する三角形の一角は８５°から９５°であり、さらに好ましくはほぼ９０°である。１２は、光の干渉効果を利用した相対的に屈折率の大きな透光性媒質と相対的に屈折率の小さな透光性媒質とを交互に積層してなる多層構造体である。多層構造体１２はその面に対して、斜めから入射する光に対して偏光を分離機能を有する。本発明においては、特に、４５°の方向から入射する光に対して偏光分離機能を発現するように、多層構造体は設計して使用される。

【００１５】１４の非偏光光は多層構造体によって、１６のｐ偏光光と１５のｓ偏光光に分離され、ｐ偏光光１６は多層構造体１２を透過し、ｓ偏光光１５は２度反射して戻る。これにより、非光吸収型の偏光素子として用いることができる。

【００１６】エッジライト型バックライトの導光体からは全反射条件を回避するように導光体表面の形状を選択する。この全反射条件を回避する導光体表面の形状に関して、導光体表面に白色の拡散材を形成する方法と導光体表面にレンチキュラーあるいはプリズムのフレネル形状を形成する方法が知られている。

【００１７】しかし、一般に、導光体からはその面に直角に光を取り出すことは困難であり、上記のような工夫をしても通常２０°から３５°にしかとりだせない。そこで、面状導光体の光出射面側に、出射する光が面状導光体に対してほぼ直角になるような光偏向手段を設ける。

【００１８】光偏向手段は、面状導光体内を出射する光線の平均的光軸を含む面での断面が三角形状の柱状プリ段の三角形状の柱状プリズムの面状導光体に面する三角形の一角が５０°から７５°とされることが好ましい。

【００１９】このような構成により、多層構造体を透過したｐ偏光成分は偏光板を透過した後液晶表示素子へ入射し、ｓ偏光成分は面状導光体内へと反射される。この引き戻されたｓ偏光成分は面状導光体の表面で反射を繰り返して導光される際、位相変化が生じ、ｐ偏光成分が生成され、前記多層構造体を透過しうるようになる。したがって、多層構造体で反射されたｓ偏光成分も面状導光体表面で反射を繰り返すにことによってｐ偏光成分に変換される成分が生じ、液晶表示素子へと透過する成分に寄与する。その結果、多層構造体を用い直線偏光光を取り出すことによる光量ロスはわずかで、液晶表示素子への光利用効率の高い直線偏光平面光源として機能する平面状の照明装置が得られる。

【００２０】本発明の液晶表示装置において、エッジライト型平面照明装置に適用した場合について、その構成図である図１を用いて以下に詳述する。

【００２１】照光面である透明なアクリル樹脂板導光体３の一辺に導光体側面の長さに対応した発光長を有する蛍光ランプ１（冷陰極放電管）を密着させ、反射体からなるランプカバー２を設けてランプ出射光を導光体内に導入する。このとき、導光体中を伝搬する光の指向性（角度分布）は、蛍光ランプの配光特性・反射体の集光特性・導光板の伝搬特性等によって決まる。特に、導光体の伝搬特性は、導光体端部より入射した光を前方に送る機能と、送られた光を所定の方向に出射する機能を兼ね備えたものでなければならない。

【００２２】前者の機能は使用する材料および界面反射特性に応じて決まり、導光体３の液晶表示素子１０側においては導光体３の屈折率によって定まる全反射角θ_C以上の入射角の光が全反射されて導光体３内を伝搬し、全反射角θ_C以下の入射角の光が導光体３の表面で屈折し液晶表示素子１０側に出射される。例えば、空気（ｎ＝１．０）と透明樹脂、例えばアクリル、ポリカーボネート、ポリウレタン、ポリスチレン等のようなプラスチック（ｎは１．５程度）の界面における全反射角θ_Cは、以下の数１の程度になる。

【００２３】

【数１】$\theta_C = \sin^{-1}(1/n) = 41.8°$

【００２４】つまり、入射角が４１．８°以下の入射光が導光体３の照光面より出射することができる。

【００２５】一方、導光体の液晶表示素子と反対の面においては、アルミニウム反射面等の反射面５を形成しておけば反射光は正規反射光として導光体内を導光される。なお、反射面５は導光体３の液晶表示素子９側面での出射光を増大させるために拡散反射面としてもよい。

【００２６】一方、導光体３への光の入射角が全反射角θ_C以上の場合が大半であると導光体から出射される光

板３の液晶表示素子９側に出射させる機能が必要となる。その手段として、導光体３の表面に白色の光拡散材を形成する方法と導光体表面にレンチキュラーあるいはプリズムのフレネル形状（マイクロレンズアレイ、プリズムアレイ等）１０を形成する方法が知られているが、このような方法だけでは出射光として直線偏光光は得らない。

【００２７】エッジライト型バックライトにおいて、上述のように導光体を伝搬し出射した光の指向性は、液晶表示素子の観測者の視野角すなわち液晶表示素子面の垂直方向にはない。偏光分離器の多層膜構造体に対して、２０から４０°の角度で入射する。このように、片寄った配光分布を有する平面照明装置の配光分布を照光面の垂直方向に変換する場合、レンチキュラーあるいはプリズムのフレネル形状（マイクロレンズアレイ、プリズムアレイ等）を形成することが有効である。

【００２８】図１には偏光分離器と導光体のの間にプリズムアレイ７を導光体３中を伝搬する光の光軸方向に並列に配置した場合が示されている。すなわち、この場合、面状導光体内を出射する光線の平均的光軸を含む面での断面が三角形状の柱状プリズムをアレイ状に配置している。プリズムアレイの作用はその形状および配置（プリズム頂角を光入射側にするか光出射側にするか）に応じて、プリズムの入射面と出射面で屈折が生じるのみの場合と他の面で全反射が起こる場合とがあり、最終的に必要とする配光分布方位と多層構造体出射光の配光分布方位とから最適な形状が決定される。

【００２９】図１では、断面形状が頂角５８°の２等辺三角形のプリズムアレイを用い、頂角が多層構造体面に面するように配置している。このようなプリズムアレイを用いることにより、面状導光体から５６°近傍の出射角で透過してきた光はプリズム側面から入射し他の側面で全反射した後プリズム底面から液晶表示素子側に垂直入射方向に対応して出射される。したがって、このようなプリズムアレイを用いることにより、多層構造体から５６°近傍の出射角で放出される光の配光方位を液晶表示素子面に垂直方向のほぼ配光方位に変換することができる。

【００３０】このようにして、液晶表示素子を垂直配光方位で照光する直線偏光平面照明装置が得られる。導光体中を伝搬する光の指向性が高く、結果的に平面照明装置から出射される光の配光方位分布が垂直方向に集中し、明るい表示に対応した視野角の範囲が狭くなる場合がある。このようなときには、液晶表示素子と上述のプリズムアレイ等の偏向手段との間に、指向性を劣化させる拡散板８等の光学素子を配置することができる。

【００３１】また、導光体内を伝搬する光の指向性を劣化させるために、導光体の液晶表示素子と反対側面に形成された反射面５を拡散面としてもよい。また、多層構な凹凸構造を有するものとしてもよい。

【００３２】本発明において直線偏光光を効率良く平面平面照明装置から得るためには、多層構造体において反射され導光体内に引き戻されたｓ偏光成分を、導光体内を伝搬中に効率良くｐ偏光光に変換し再利用することが重要である。このｓ偏光光をｐ偏光光に変換する方法は種々存在するが、以下に代表例を記す。

【００３３】一般に、金属面に直線偏光光が斜入射し反射された場合、直線偏光光は金属の光学物性定数（屈折率ｎ、吸収係数ｋ）に応じて楕円偏光光となることが知られている。すなわち、ｓ偏光光が入射しても反射光にはｐ偏光成分が生成される。したがって、本発明において導光体３の液晶表示素子９と反対側の面に形成された反射面５がアルミニウム等の金属である場合、この反射面で反射されるたびにｓ偏光光の一部がｐ偏光光に変換される。

【００３４】別な方法として、偏光軸方向を回転させる素子として透光性高分子材料からなる位相差板が知られている。適当な膜厚を有するこの位相差板４を導光体３の反射面５との間に配置することにより、偏光分離器により反射されたｓ偏光光は楕円偏光になりその一部をｐ偏光光に変換することができる。図１は、この１／４位相差板４を導光体３に設けた反射面５上に密着させて効率よく偏光変換を行う構成例を示す。

【００３５】また、以上の説明では導光体に使用する透明樹脂としてアクリルを用いた場合を記したが、ポリカーボネート、ポリウレタン、ポリスチレン、シリコーン等でもよい。

【００３６】

【実施例】図１を参照しながら、本発明の実施例について説明する。照光面である透明なアクリル樹脂板導光体３の一辺に蛍光ランプ１（冷陰極放電管）を密着させ、反射体からなるランプカバー２を設けて導光体内に光を導入しするエッジライト型バックライトにおいて多層構造体である偏光分離器６を組み合わせた。

【００３７】蛍光ランプ１としては、１０インチ液晶表示面の側面長（１５２ｍｍ）に対応した長さを有し管径の細い１０Ｗとの冷陰極放電管を使用した。また、ランプカバー２としては、冷陰極放電管を包み込むような円筒形あるいは楕円筒形の反射鏡を、導光体３としては、アクリル樹脂製の透光性導光板（ｎはほぼ１．５）で大きさは１６０ｍｍ×２２０ｍｍ×５ｍｍのものを用いた。

【００３８】さらに、導光体３の裏面および蛍光ランプ設置面に対向する導光体側面に位相差板４を設け、その上にＡｌ金属反射膜からなる反射面を形成した。また、プリズムアレイ８として、断面形状が頂角５８°の２等辺三角形のプリズムアレイを用い、頂角が導光板３に面するように配置した。プリズムアレイ板の厚さは２ｍｍ

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偏光分離器６を装着した。さらに、偏光分離器６の光出射面側には、拡散板８を、視野角を広げるために用いた。

【００３９】液晶表示素子９としては、ＴＦＴ駆動のＴＮ液晶であって、ＶＧＡ対応画素数を有するＲＧＢカラーＴＦＴ駆動ＴＮ液晶表示セルを用いた。

【００４０】偏光分離器６の出射光の偏光軸と液晶表示素子９の入射側偏光板の偏光軸とを略一致させた。

【００４１】液晶表示素子９の出射側偏光板も同様に光吸収型有機偏光板を用いた。偏光軸の向きは表示モード（ノーマリホワイト、ノーマリブラック）によって適宜選ばれるが、本実施例では、ノーマリホワイト表示とし、入射側面の偏光板の偏光軸に対して９０°偏光軸が回転した方向に出射側面の偏光板の偏光軸をとった。光源には１０Ｗの蛍光ランプを使用した。

【００４２】比較例として、位相差板４と偏光分離器６を使用しない場合を行った結果、実施例の方が比較例よ

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りも１．５倍大きかった。

【００４３】

【発明の効果】本発明により、光の利用効率の高い液晶表示装置と、それに適した照明装置が得られる。

【図面の簡単な説明】

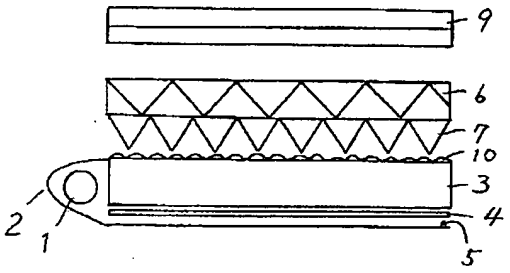
【図１】本発明の実施例を示した断面図

【図２】本発明の偏光分離器を示した断面図

【符号の説明】

１：蛍光ランプ
２：ランプカバー
３：導光体
４：位相差板
５：反射面
６：偏光分離器
７：プリズムアレイ
８：拡散板
９：液晶表示素子

【図１】



【図２】